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AMERICA AND THE WHEAT PROBLEM.

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NOT since Tyndall shocked the religious sentiment of almost the entire English-speaking world, by proposing at the Belfast meeting in 1874 that certain wards of a hospital should be set apart for a scientific test of the efficacy of prayer, has the annual address of a president of the British Association for the Advancement of Science excited so general an interest, or provoked so much unfavorable criticism, as have the recent utterances of Sir William Crookes on the subject of an approaching scarcity in the supply of wheat.

In the United States, the warning—for such, rather than as a prediction, it should be considered—of the distinguished chemist has been received with a chorus of deprecation in which there was scarcely a discordant voice, the idea that the wheat-producing capabilities of this country are not practically illimitable being generally scouted as preposterous. Much of the criticism, however, was founded upon a telegraphic report, which, however creditable to newspaper enterprise, was not entirely accurate; and now that the address is available in complete form,* it may be worth our while to examine it with some degree of care, with a view to determining its actual bearing upon prospective conditions in this country.

The field covered by Sir William's argument is of immense extent. It is practically the entire wheat-producing region of the world, and the potentiality of every considerable portion of it is discussed in more or less detail and, in the main, conservatively. To follow the explorer, however, from Europe to Siberia, from

* British Association for the Advancement of Science. Bristol, 1898. Address by Sir William Crookes, F. R. S., V. P. C. S., President. London, 1898.

Canada to Australia, from South America to Africa, would be less useful, because less conclusive, than would be a consideration of the conditions, actual and prospective, in the United States, the country which, as he himself says, has for the last thirty years been the dominant factor in the world's supply. Sir William's references to the United States constitute less than one-twentieth part of his discussion of the wheat-supply problem, and are mainly embodied in the following statements:

"Practically there remains no uncultivated prairie land in the United States suitable for wheat growing. The virgin land has been rapidly absorbed, until at present there is no land left for wheat without reducing the area for maize, hay and other necessary crops.

"It is almost certain that within a generation the ever-increasing population of the United States will consume all the wheat grown within its borders, and will be driven to import, and, like ourselves, will scramble for a lion's share of the wheat crop of the world."

What it is sought to establish is that, not in the immediate future, but when almost a third of the coming century—practically a generation—shall have passed away, the wheat supply of the world, including the United States, will fall so far short of the demand as to constitute general scarcity, unless starvation be averted through the laboratory. This is Sir William Crookes' contention, and it is the object of the present article to consider, from a standpoint somewhat different from that either of the English chemist or his critics, what are likely to be the prevailing agricultural conditions in the United States a generation hence.

What were the conditions a generation ago? The country then had a population of about 34,000,000; now it has one of about 75,000,000, exclusive of the islands to be brought under its dominion as a result of the war with Spain. One hundred and ninety-one million bushels was the largest wheat crop on record; the average of the last three years has fallen but little, if any, short of 540,000,000 bushels. In the fiscal year 1865-66 the total exports of wheat, including wheat flour, were less than 16,500,000 bushels; last year they exceeded 217,000,000 bushels. In 1865 the corn crop was only 704,000,000 bushels, with 828,000,000 bushels as the high water-mark of previous production; during the last three years the crop has averaged over 2,000,000,000 bushels.

Were there really no limit to the agricultural potentiality of the United States, these enormous figures might furnish some sort of index to the probable developments of the future. But we are liable to be led seriously astray if we assume for the thirty-three

years to come an increase proportionate to that of the thirty-three years last past. That the population of the United States in 1931, exclusive of colonial possessions or dependencies, will be at least 130,000,000 is as certain as any future event can be, but it is not nearly so easy a matter to forecast the agricultural production of that period; and yet the question that lies at the very foundation of any just criticism of Sir William Crookes' address is, what contribution, if any, our farmers will be able to make to the wheat supply of other countries, when the time comes that provision has to be made for the varied requirements of a home population more than twice as large as that at the last federal census.

Those requirements will include a wheat crop of 700,000,000 bushels, without a bushel for export; an oat crop of 1,250,000,000 bushels; a corn crop of 3,450,000,000 bushels, and a hay crop of 100,000,000 tons, all for domestic consumption; with cotton and wool, fruit and vegetables, dairy and poultry products, meats and innumerable minor commodities in corresponding proportions. The area necessary to the production of the three principal cereals alone will be over 15 per cent. greater than the enormous total acreage devoted in 1898 to grain, cotton and hay, while the mere addition of the two last mentioned products and of the minor cereals will call for an acreage exceeding the total area of improved land in farms at the present time.

But what, it may be asked, is to prevent either (1.) any necessary extension of the areas in farms, or (2.) the bringing under cultivation of that large residue of unimproved land which amounted at the last federal census to no less than 42.6 per cent. of the total farm area?

The great fact that underlies the enormous productive capacity of the United States to-day is, of course, the transfer from government ownership to individual proprietors, within a single generation, of a body of land hundreds of millions of acres in extent and for the most part of extraordinary fertility. But, amazing as has been the increase in the farm area of the country during the last thirty years, it has not been sufficient even to keep pace with the growth of population. The addition of 128,300,000 acres, or 31.48 per cent., to the area in farms between 1870 and 1880 only increased the area *per capita* of population from 10.57 to 10.69 acres. By 1890 the area, notwithstanding a further addition of

87,100,000 acres, or 16.25 per cent., amounted to only 9.95 acres *per capita*, and the census of 1900 will almost certainly find it under 9 acres.

That for general agricultural purposes the public domain is practically exhausted, and that consequently there can be no further considerable addition to the farm area of the country, is too well-established a fact to be the subject of controversy. Of the entire area undisposed of, 72.7 per cent. is in states wholly within the arid region, and all but a small part of the remainder is desert, mountain, or at best suitable only for grazing purposes.* In Kansas, out of 1,061,000 acres undisposed of, only 116,000 acres are east of the 100th meridian, and these are described as broken and for the most part sandy. In Nebraska 10,548,000 acres are still open to settlement, but not one acre in seven is in a region of sufficient rainfall for general agricultural purposes, and the best of the land is described by the General Land Office as fit only for grazing. In North Dakota the vacant land amounts to 20,575,000 acres, but on little more than one-tenth of this area could irrigation be dispensed with, even if the land were otherwise adapted to general farming. In Oklahoma, the youngest of the territories and the one containing the largest addition to the farm area of the country that has been made within many years, of the 7,007,000 acres of government land still vacant, 3,250,000 acres lie between the 99th and 100th meridians and a like amount, making altogether 93 per cent. of the whole, west of the 100th. The vacant land in the Pacific states amounts to 91,843,000 acres; but of the 42,503,000 acres in California, 19,000,000 acres are "barren, irreclaimable wastes," 19,875,000 acres "desert and grazing," and 3,628,000 acres "woodland and forest;" the 35,898,000 acres in Oregon include 17,067,000 acres of "desert and grazing" and 18,831,000 acres of "woodland and forest," while the 13,443,000 acres in Washington comprise 3,847,000 acres of "desert and grazing" and 9,596,000 acres of "woodland and forest."

It should not be forgotten, in this connection, that it is no longer the policy of the American people or of its representatives

* The figures relative to the public lands and the possibilities of irrigation are taken from the Report of the Secretary of the Interior for the fiscal year ended June 30, 1898, pp. 15-16; the Annual Reports of the Commissioner of the General Land Office for the fiscal years ended June 30, 1897 and 1898, and The Public Lands and their Water Supply by Frederick Haynes Newell, Sixteenth Annual Report of the U. S. Geological Survey, 1894-95, Part II., pp. 463-533.

in Congress to permit of the continued destruction of the national forests, without regard to the needs of the future. It should also be borne in mind that, according to the U. S. Geological Survey, the entire water supply of the Pacific states available for irrigation is only sufficient for some 23,000,000 additional acres, or about one acre in four of the unappropriated public lands in those states. In the entire arid region the available water supply, as similarly estimated by the U. S. Geological Survey, is only sufficient for the irrigation of 71,500,000 additional acres, or one acre in seven and one-half of the area undisposed of. Commenting upon the difficulties encountered by the individual farmer in reclaiming land from its desert condition, the Commissioner of the General Land Office, in his report for the fiscal year ended June 30, 1898, p. 72, calls attention to the fact that such reclamation amounts to "less than 125,000 acres annually, at which rate it would require nearly six hundred years to dispose of all the irrigable lands." Commissioner Hermann says further:

"In connection with these astounding figures, it should not be overlooked that much the greater part of the lands already disposed of are those bordering on small streams, where reclamation was accomplished principally through individual efforts.

"Nearly all of the waters of these smaller streams are now utilized, and the remaining lands depend for their reclamation upon the saving of all overflow waters, and the diverting of the waters of the larger streams, which can be done only by expensive construction. It is, therefore, but a fair presumption that the disposal of desert lands to individuals will annually decrease, unless Congress in its wisdom provides a means by which the annual overflow waters in the arid region may be saved and intelligently dispensed."

The extent to which the total farm area of the country can be increased by the reclamation of desert lands will therefore be seen to be very small, if not absolutely insignificant; indeed, it is a question whether it will be sufficient even to counterbalance those constant encroachments upon the productive area which arise from the growth of cities,* the building of railroads, and the general development of commerce and of non-agricultural industry.†

* At the census of 1890, of the counties containing the 28 most populous cities in the country, 20 had a smaller number of farms, and 23 a smaller farm area and smaller area of improved land in farms than they had in 1880. Of the exceptions, all but three were due to the increase in the number and area of market gardens, which, for census purposes, were considered as farms.

† It is difficult to estimate the amount of land annually withdrawn from the farm area of the country, but the statistics of improved and unimproved land at the Eleventh Census show incidentally that at least 4,500,000 acres of the former and 6,500,000 acres of the latter passed out of farms during the preceding ten years, an average of more than one million acres per annum.

But what of that vast body of unimproved land already in farms, which amounted at the last census to 265,600,000 acres, or more than two-fifths of the total farm area of the country? Where is it situated, and of what does it consist?

If its distribution is not uniform with that of the area improved, it is no less general. No section of the country, large or small, has been too long settled, none has a too easily cultivable soil, none has too good a market in proximity to it, to be exempt from making a relatively substantial contribution to the unimproved acreage in farms. There was not one of the 2,783 counties at the Eleventh Census that failed to contribute to the grand total, whether situated in the richest part of the Mississippi Valley or embracing some great center of population.*

Between the international line and the 37th parallel (which runs through Hampton Roads, Va., Cairo, Ill., across the southern part of Missouri, and forms the northern boundary of Indian Territory and Oklahoma) and east of the 100th meridian, the census of 1890 found about 115,000,000 acres of unimproved land in farms, ranging from 15.8 per cent. of the total farm area in Illinois to 55.9 per cent. of that in West Virginia. South of the 37th parallel and east of the 100th meridian there were about 118,000,000 acres, ranging from 53.6 per cent. of the total farm area in Tennessee to 68.8 per cent. of that in Florida. Within the region that is absolutely arid were about 27,000,000 acres, ranging from 53.4 per cent. of the total farm area in Montana to 92 per cent. of that in Arizona, and in those portions of the Pacific states in which irrigation is unnecessary were found the remaining 5,500,000 acres.

The chief factor in determining the ratio of unimproved land in farms to total farm area is not the cost of the land—not the facility with which it has been acquired—but the relative facility of cultivation. The percentage of unimproved land is higher in all the New England states, except Connecticut, than in either of the two Dakotas, with their immense areas of newly opened farms, and it is higher in almost every southern state than even in Montana, Idaho, Utah or Nevada.

The enumerators of the Tenth and Eleventh Censuses were instructed to report as "improved" all tilled land, including fallow

* The counties containing the cities of New York, Boston, Jersey City, St. Louis, and San Francisco, had 115, 451, 135, 422 and 366 acres of unimproved land in farms, respectively.

and grass in rotation, whether pasture or meadow, and all permanent meadows, permanent pastures, orchards and vineyards. As "unimproved" they were instructed to report all natural woodland and forest within farm limits, all unplowed land, and all land that, once plowed, has since been abandoned for cultivation, like the "old fields" of the South. They were specifically directed that rocky, hill and mountain pastures were not to be reported as improved land.

With this distinction clearly in mind, a brief survey of the conditions existing in the grand divisions above specified should prove instructive.

With regard, first, to the unimproved land in farms in the arid region, there will apply with almost equal force much of what has been quoted from the Report of the Commissioner of the General Land Office against the probability of any considerable increase in the total farm area. On irrigated lands, the yield per acre is relatively so high that the farmer in the arid region has every inducement to utilize, to the fullest extent, such portions of his farm as are irrigable. The land easily irrigated has, therefore, to a large extent, been already brought under cultivation, and is annually contributing to the fruit, grain and forage crops of the country. The developments of the future will be slow and costly. The average first cost of preparing the soil for cultivation in the arid region, as determined by Mr. Frederick H. Newell in connection with the Eleventh Census,* was \$13.51 per acre, and the average first cost of water rights \$8.23 per acre, making \$21.74 as the average cost per acre of reclaiming such of the desert lands as were the most easily irrigated. In the eight states and territories lying wholly within the arid region the irrigated land constituted but little more than two-fifths of the land reported as in some sense improved, so the chances for the reclamation of the still larger body of land upon which no improvements whatever had been made are exceedingly remote. They are for the most part grazing lands and such they will doubtless remain.

Among the various astounding assertions called forth by the discussion of Sir William Crookes' address is the statement that, with wheat at one dollar per bushel, the annual production of that cereal in the state of Idaho alone might reach 400,000,000 bush-

* Report on Agriculture by Irrigation in the Western part of the United States at the Eleventh Census: 1890. By F. H. Newell, Special Agent. 1894.

els ! It is amazing that such an assertion should be given place in an article written in 1898 for a scientific publication. While farming without irrigation is successful along the northwestern edge of this most interesting and beautiful state, the state is for the most part made up of mountain, forest and desert. Its mean elevation is 4,700 feet, and over 15,000 square miles of its area is from 6,000 to 11,000 feet above sea-level. Many of its valleys and the lower slopes of its mountains are covered with a dense forest, the removal of which would be only preparatory to the construction of more or less costly irrigation works. Of every 100 acres of its land surface, statistically considered, 84 acres are still without settlers, and of these, 34 acres are desert and 50 acres forest. The entire arable land of the state has been estimated by Mr. Henry Gannett, geographer of the U. S. Geological Survey and of the Tenth and Eleventh Censuses, at rather less than 4,000,000 acres, and Mr. F. H. Newell, hydrographer of the U. S. Geological Survey, in estimating the water-supply as sufficient for the reclamation of 7,000,000 acres, makes by implication the highest estimate of the agricultural possibilities of the state that has been made by any competent and disinterested authority. Even the State Engineer estimates the amount of land that can ultimately be cultivated by irrigation in Idaho as not more than four or five millions of acres in the aggregate.* On the basis of reports from nearly five hundred local correspondents, the Department of Agriculture estimates the wheat crop of Idaho for the present year at but little more than 4,000,000 bushels, while commercial authorities in general content themselves with including it, with other states of small production, under the head of "other" or "sundry." What a fortunate thing it is that the country has been warned in advance, so that business may not be too seriously demoralized by the sudden marketing of a 400,000,000 bushel crop !

Let us turn now to that important group of states lying south of the 37th parallel and wholly or mainly east of the 100th meridian. These states contain about 22 per cent. of the entire land surface of the country, and about 29 per cent. of its total farm area. But, while their improved farm acreage is only 21 per cent. of that of the country at large, the land included in their farms

* First Biennial Report of the State Engineer to the Governor of Idaho. December, 1896. Page 7.

and plantations and remaining in a state of nature constitutes no less than 44 per cent. of the total unimproved farm area of the country, or a larger proportion of the total farm area within which it is embraced than is to be found in any other group of states, not excepting even those of the arid region. The reason for this is not far to seek. Excluding Texas, the unimproved land of which is mainly prairie, of every 100 acres of unimproved land in farms in the states under consideration 86 were at the Tenth Census covered with forest and woodlands, the percentage ranging from 78 in South Carolina to 93 in Florida and Arkansas.

The soil of this forest area* is to a large extent of so inferior a quality that there is but little inducement to attempt its reclamation, and even after the merchantable timber has been removed from it but little effort is made to utilize it for farm purposes. This is owing to the fact that it is its mechanical rather than its chemical constitution that presents the most serious obstacle to such utilization. Containing, for the most part, an exceedingly large percentage of sand, the obstacle it presents to successful cultivation is not one that can be overcome by the use of commercial fertilizers, except for forage crops and vegetables.

While, therefore, each succeeding census will probably find some relatively small portion of it added to the cultivated lands of the various states, it cannot have the slightest bearing upon the much discussed wheat problem. For such wheat production as the farmers of the South are engaged in, the lands best adapted to the growth of that cereal are assigned, and yet in the ten years ending with 1897 the ten principal cotton states produced an average annual crop of only 23,610,671 bushels, the average annual yield per acre being only 8 bushels. Between 1880 and 1890 these states, together with Virginia, increased their area in cotton by 5,630,000 acres, their area in corn by 1,140,000 acres, their area mown by 1,320,000 acres, and the number of their milch cows by 630,000. Their area in wheat, however, showed a decline of 1,150,000 acres, a fact that need occasion no surprise when it is considered that the average value of farm products per acre of improved land in these states is in inverse ratio to the extent of their wheat production.

* See Report on Cotton Production in the United States, by E. W. Hilgard, Ph. D., Vols. V.-VI., of the Tenth Census Reports. Forestry Conditions and Interests of Wisconsin, by Filibert Roth, U. S. Department of Agriculture, 1898, may also be consulted with reference to the use of pine lands for agricultural purposes.

There are writers who seem to imagine that the price or exchangeability of a product is the sole factor in determining the extent of its production everywhere and at all times; but this certainly does not hold good where the cultivation of the product is so difficult and precarious as is that of wheat in the southern states. For this reason, were wheat to be worth a dollar per bushel, no largely increased production need be looked for in the South. From 1879 to 1883, inclusive, the average price of wheat in Chicago was \$1.08, and even the average December farm price was \$1.01. During these five years, however, the total wheat production of the ten principal cotton states averaged only 24,270,000 bushels per annum, or but 660,000 bushels more than the average during the ten years ending with 1897. It is not, of course, contended that \$1 per bushel fifteen or twenty years ago was the equivalent of the same price at the present time, but simply that a relatively high price failed to increase production, owing to the limitations imposed by physical conditions.

In discussing agricultural potentialities much misconception arises from taking the state as the geographical unit. From the fact that North Carolina contributes annually some four or five million bushels of wheat to the total production of the country, it might be supposed that its production could be very largely increased; but an examination of the statistics by counties discloses the fact that the crop is grown almost entirely on the high lands on the western border of the state, adjoining the Blue Ridge and Great Smoky Mountains; and with regard to the adjoining state of South Carolina, no less than 97 per cent. of its wheat crop at the last census was produced in the counties embraced within the Piedmont and Alpine sections of the state. Still, the average annual yield per acre in the two States for the last 10 years has been only 6.3 and 5.9 bushels, respectively.

In Tennessee, Texas and Oklahoma the conditions are somewhat different from those obtaining in the other states south of the 37th parallel, but the favorable conditions that render possible the larger production in these states are more or less localized and no really great extension of this branch of agriculture is to be looked for within their borders, even under the stimulus of high prices. This is equally true of Indian Territory, a region that lies wholly within the Lower Austral life zone and the large and increasing cotton production of which is itself the very

strongest argument against the possibility of developments in the production of wheat that will be more than a mere drop in the bucket. Nature has decreed that a profitable return on the cost of cultivation shall become less and less to be depended on the farther the departure from the region to which the plant is indigenous, and the operation of this law can be arrested, in the case of wheat growing, only by topographic conditions—chiefly that of elevation above sea-level—that do not exist in Indian Territory.*

It is the firm belief of the writer that with a more diversified agriculture—in the direction of which a gratifying tendency is already observable—and with the continued development of its manufacturing industries, the South will soon enter upon an era of great prosperity, but its contribution to the wheat crop will continue to be but small.

This brings us to the consideration of that marvellous agricultural region extending from the international line to the 37th parallel and from the Atlantic Ocean to the 100th meridian—a region containing only 30 per cent. of the entire land surface of the country, but yet embracing 59 per cent. of its total farm area and nearly 71 per cent. of its improved farm acreage. The twenty-six states in this division contributed last year 82 per cent. of the total corn crop, 76 per cent. of the total wheat crop, 91 per cent. of the total oat crop, 83 per cent. of the total hay crop, and a correspondingly large proportion of the total production of every other agricultural product, save cotton, sugar cane, and the tropical and sub-tropical fruits, grown in the United States. It is obvious, moreover, that this is the region that must continue to furnish the principal proportion of all these necessary commodities.

The fact that at the census of 1890 these states contained about 115,000,000 acres of unimproved land in farms would suggest enormous agricultural possibilities, but unfortunately these large figures are to some extent delusive. Here, as in other parts of the country, the distribution of the unimproved land is anything but uniform, and the extent to which such land might be made available for cultivation likewise differs widely. In Illinois and Iowa it constitutes between 15 and 20 per cent. of the total

*The Republic of Mexico had a very creditable exhibit of wheat at the recent Trans-Mississippi Exposition at Omaha, but it was grown at an elevation of several thousand feet above sea-level.

farm area; in New York, New Jersey, Pennsylvania, Delaware, Ohio, Indiana, Kansas and Nebraska, between 20 and 30 per cent.; in Vermont, Connecticut, Maryland, Michigan, Missouri, North Dakota and South Dakota, between 30 and 40 per cent.; in Massachusetts, Rhode Island, Kentucky, Wisconsin and Minnesota between 40 and 50 per cent., and in Maine, New Hampshire, Virginia and West Virginia, between 50 and 60 per cent. It will readily occur to the reader that these differences are largely a matter of topography—indeed only a superficial acquaintance with the natural characteristics of the different states is necessary to placing nearly all of them in their respective categories. The question is: How near do these various figures come to indicating the amount of additional land that might be brought under cultivation under the stimulus of higher prices for agricultural products? This we should be able to determine with a sufficiently close approximation to the truth by a brief examination of the conditions obtaining in certain typical states.

Beginning with Illinois, we find that at the Eleventh Census that state contained 10,116 miles of railroad and 69 towns and cities of 3,000 inhabitants or upward, of which 21 contained 10,000 or upward. It had enjoyed periods of great agricultural prosperity since it became fully settled; it possessed within its borders the greatest produce market and shipping point in the world; its agriculture was of the most diversified character, and its farmers had every inducement to make the most of the agricultural capabilities of their farms. Is it unreasonable, then, to suppose that its residue of unimproved land, 15.8 per cent., represented, if not an absolutely irreducible minimum, at least that proportion of the entire farm area which—containing, as it did, not only all waste land, but farm yards, private roads, wood lots and natural pastures—not even an era of high prices would bring under cultivation? In Iowa the conditions were in all essential respects the same, and the percentage of unimproved land differed but very slightly, being 16.6 per cent. of the whole. Ohio has been longer settled, but its surface is more broken, and its percentage was 21.5. In Pennsylvania the percentage was 28.1, many counties in the mountain region averaging over 40 per cent. and some very much higher. In Kentucky a naturally somewhat high percentage is rendered still higher by the inclusion of many fine natural parks and pastures among the unimproved. In Kansas, Nebraska, Min-

nesota and the Dakotas, averages of from 26 to 40 per cent. are mainly attributable to the more recent settlement of those states.

Assuming that the entire region will, under the influence of high prices, have 85 per cent. of its total farm area brought under cultivation within the next 30 years, there will be added to the productive area in this region about 60,000,000 acres, with state and railroad lands to the possible extent of 20,000,000 acres in addition. This will fall so far short of the requirements of our own population that it is necessary to seek other possible additions to the cultivable area.

Not for the purpose of growing wheat, but under the influence of those generally higher prices which any considerable and long-continued increase in the price of wheat would bring about by reducing the acreage in other products, the South might conceivably add to her productive area as much as 30,000,000 acres. Ten million acres might be added on the Pacific coast and 3,000,000 acres in the arid region. This would make the gross addition 123,000,000 acres, against which must be set those continual withdrawals of land from agricultural uses which not even a high degree of agricultural prosperity would entirely prevent. Assuming the annual rate of diversion to be diminished by one-half, the loss during the next thirty years would amount to about 15,000,000 acres, making the net increase 108,000,000 acres.

This will constitute an enormous addition to the productive capacity of the farms of the country, and one the contemplation of which, aside from the question of consumption, might well appal our much-discouraged farmers. Considered, however, in the light of the requirements of a population of 130,000,000, the figures assume an entirely different aspect. On the basis of our present actual consumption as a people, to the entire exclusion of our export trade, the country will require by the year 1931 the following additional acreage: for wheat, 13,500,000 acres; for corn, 66,000,000 acres; for oats, 23,700,000 acres; for the minor cereals, 10,000,000 acres, and for hay, 40,500,000 acres, a total of 153,700,000 acres, without making any provision for the proportionately increased consumption of vegetables, fruits and other products. Instead, therefore, of the probably largely increased acreage bringing down prices or proving unprofitable to the farmers, there will be a deficiency of at least 50,000,000 acres. Indeed, it will be more than this, since it cannot be supposed for a moment

that the unimproved lands left to the last are anything like equal in natural fertility to those first selected for cultivation. On the other side of the account, however, we have to place whatever increase in yield per acre may be brought about by improved methods of farming. But whatever agricultural science may be able to do in this direction within the next thirty years, up to the present time it has only succeeded in arresting that decline in the rate of production with which we have been continually threatened.

From 1878 to 1882, inclusive, the average yield per acre of wheat was 12.8 bushels; from 1883 to 1887 it was 11.9 bushels; from 1888 to 1892 it was 12.8 bushels, and from 1893 to 1897 it was likewise 12.8 bushels. While it has been remarkably uniform when considered in 5-year periods, it would unquestionably show a slight decline, were it not for the very high averages obtaining in those states and territories the crops of which are irrigated, and which have appeared in the list of wheat-growing states only within the last fifteen years. The average yield per acre of corn for the 10-year period, 1878 to 1887, was 24.40 bushels; from 1888 to 1897 it was 24.42 bushels. Of oats the average yield was 27.2 bushels in the former and 25.7 bushels in the latter period. Of potatoes the average yield per acre declined from 77.6 bushels to 76.0 bushels; of cotton it declined from 181 pounds to 172 pounds, and of tobacco from 727 pounds to 726 pounds. Of hay the latter period shows an increase of one one-hundredth of a ton per acre per annum, and there is also a slight increase in the case of barley, rye and buckwheat.

While there is but little satisfaction to be obtained from these figures, it must be borne in mind that it is only to a very small extent indeed that scientific methods have as yet been employed in the growing of field crops. It is unquestionably to the laboratory that we shall have to look for relief, except in so far as it may be afforded by the Government undertaking the construction of storage reservoirs in the arid region that might reclaim not to exceed 71,500,000 acres, less whatever small area might in the mean time have been brought under cultivation in that region through private enterprise.

So much as to the prospective crop situation in general; what as to the question of wheat production? That it is to the crop most readily convertible into money that, all other things being equal, the farmer will give the preference in determining what he

will grow, needs no proof. The cultivation of wheat at the expense of other necessary crops will, however, be held in check by two very powerful influences. The first will arise from the fact that a reduction of the acreage under any product of general use below the actual requirements of the country will instantly—perhaps even prospectively—affect the price of that product, possibly in a proportion even greater than that by which its acreage is diminished, and may even be sufficient to constitute it a competitor with wheat on equal terms for the farmer's favor. The second check will be found in the fact that the American farmer, north, south, east and west, has at last fully awakened to the safety, stability and, in the long run, increased profit resulting from a judiciously diversified system of farming. The one-crop system has passed away, never to return, and before wheat can be extensively cultivated at the expense of other products it will not only have to command what would now appear to us as an excessively high price and afford a reasonable assurance of its continuing so to do, but would have to do this without affecting to any considerable extent the price of other products.

There is yet one more factor to be considered, namely, the possibility that, to a much larger extent than has ever yet been attempted or contemplated, the farmers in the different sections of the country will restrict their products to what they can raise most abundantly and most cheaply, so that the regions best adapted to wheat shall raise wheat, and so on through the entire category of farm products. This, however, would also be to a very large extent counter to that system of diversification which the writer regards as the most encouraging feature of the agriculture of our time, and while some change may be looked for in this direction, it is doubtful if it will play any very important part in our new rural economy.

To discuss the extent to which under conceivable conditions the United States may, notwithstanding this somewhat dubious outlook, still continue to contribute to the food supply of other nations, would be little more than speculation. It is sufficient for the writer's present purpose to have called attention to the enormous prospective increase in the requirements of our own population and to some of the changes in the agricultural situation which such increase will involve.

JOHN HYDE.